KI 9600 Series
Power Meter

KI 9800 Series
Light Source

OPERATION & MAINTENANCE GUIDE

KINGFISHER INTERNATIONAL

DECLARATION OF CONFORMITY

IN ACCORDANCE WITH ISO/IEC 17050:2004

Manufacturer's Name: Kingfisher International Pty. Ltd.
Manufacturer's Address: 30 Rocco Drive, Scoresby, Victoria 3179, Australia

hereby declares, that the products listed below

Product Name: **Light Source, Power Meter**
Model Number: **KI9800 Series, KI9600 Series**
Product Options: *This declaration covers all options of the above product(s)*

comply with the essential requirements of the applicable European Directives:

- Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC, amended by 93/68/EEC, and carries the CE marking accordingly
- Directive 2002/95/EC on restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)
- Directive 2002/96/EC on waste electrical and electronic equipment (WEEE)

and conform to the following standards and specifications:

MIL-PRF-28800F: 1996 Performance specification-Test equipment for use with electrical and electronic equipment, general specification
IEC 60529: 2001/ EN 60529:1993+A1:2003 Degrees of protection provided by enclosures

Power Meter conforms to:
IEC 61315: 2005 Calibration of fibre-optic power meters

EMC	**Limit**
IEC 61326:2002 / EN 61326-1:1997+A1:1998+A2:2001+A3:2003	
IEC CISPR 11: 2004/ EN 55011:1998+A1:1999	Limits applicable to Group 1 Class B equipment
IEC CISPR 16-1:1999	Limits applicable to Class B equipment
IEC CISPR 16-2:1999	Limits applicable to Class B equipment
IEC 61000-4-2:2001 / EN 61000-4-2:1995+A1:1998+A2:2001	4kV CD, 8kV AD
IEC 61000-4-3:2002/ EN 61000-4-3:2002	3V/m, 80-1000MHz
ICES-001: 2006 (Canada)	
CFR 47 FCC Part 15, Subpart B (Class B) (USA)	

FCC registration number: 90891

Safety

Light Source conforms to:
IEC 60825-1:2001 Safety of laser products - Equipment classification, requirements and user's guide
IEC 60825-2:2005 Safety of laser products - Safety of optical fibre communication systems (OFCS)
CFR 21 part 1040.10 (USA) Performance standards for light- emitting products-Laser products

Supplemental Information:

The product was tested in a typical configuration with Kingfisher International test systems.

2008-December17
Date

Bruce Robertson
Name

Technical Director
Title

For further information, please contact your local Kingfisher International sales office, agent or distributor.

OPERATION MANUAL

KI 9600 Series Optical Power Meter

KI 9800 Series Optical Light Source

Congratulations on your purchase of this instrument, which has been engineered to provide the best possible reliability, convenience and performance. To get the best use from your equipment and ensure its safe operation, please spend a few minutes to read this manual.

Made in Australia. International Patents Granted
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3d Edition, May 2009.

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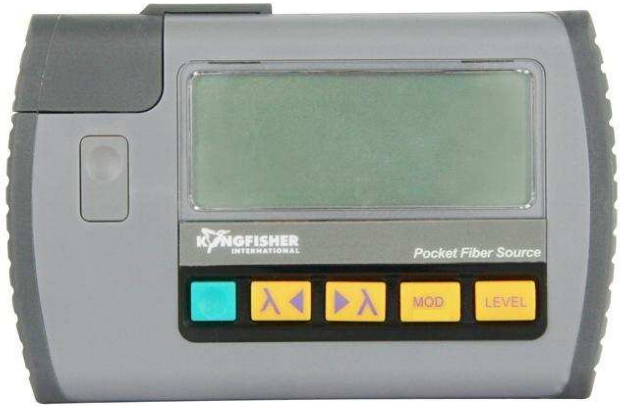
KI9600 Series Optical Power Meter and KI9800 Series Optical Light Source



SERVICE AND SUPPORT

Applications Support

Please visit www.kingfisher.com.au to see our comprehensive **Application Notes** written to support instrument users.

Look at www.kingfisher.com.au to find distributor details from the **Contact Us** section.

Our local agents are able to offer excellent applications advice in your language and time zone.

Please visit our website on www.kingfisher.com.au for a current list of regional service centres.

Otherwise if you are having difficulties please feel free to contact sales@kingfisher.com.au for applications support.

Instrument Service

Qualified personnel must perform adjustment, maintenance or repair of this product. To obtain service, please contact your local Kingfisher International distributor or our office in Australia:

Tel: (61) 3-9757-4100
Fax: (61) 3-9757-4193
Email: sales@kingfisher.com.au

If returning equipment to Kingfisher International for service or calibration, please download and complete the **Return Material Authorization Form** located on the **Support** page on our web site www.kingfisher.com.au .

To avoid delays and minimise disruption for our customers, Kingfisher International offers a fixed price repair service.

For the staff at our fully equipped service and calibration centre, it is their pleasure to keep your equipment performing at its very best.

INTRODUCTION AND APPLICATIONS

The KI 9000 Series Optical Power Meter and Optical Light Source offer superb measurement confidence, ease of use, high level of convenience and reduced cost of ownership. This equipment can be effectively used by installers, technicians and engineers to test all types of fiber optic systems in various applications (SMF, MMF, POF, PCS, ribbon fiber):

- Tx / Rx absolute power levels in dBm
- Optical loss in dB
- Continuity testing with the test tone features

The interchangeable optical connectors are drop and dust protected by a snap on cover. A wide variety of connector styles are available, including 1.25 mm LC and MU styles.

KI9000 Series feature a tough polycarbonate housing with shock absorbent sides and corners, which has passed extensive drop testing.

Calibration can be performed by any suitably equipped laboratory. The recommended re-calibration cycle is 3 years.

Power Meter features

Superior measurement confidence is achieved with a unique Total Uncertainty Specification, which covers the full temperature, measurement and connector range. NATA/ILAC traceable calibration certificate is supplied.

The sensitive optical tone detector displays the actual measured tone frequency in Hz. If a standard tone is detected, the buzzer sounds, which is useful for fiber identification and continuity testing.

Power stability testing is performed using the max/min recording function. The display shows dBm, dB and linear units, and can be put on hold for data recording.

This power meter works with fiber core diameter up to 200 micron, with both PC and APC polish connectors.

Detector options include Germanium (Ge), Indium Gallium Arsenide (InGaAs), wavelength selective and large area detectors.

Power meter calibration options are available from 470 nm to 1625 nm and power levels from +24 to - 80 dBm.

Light Source features

Multiple wavelength sources have switchable wavelengths through one port, which makes operation faster. Laser sources at 1490/1310/1550 nm used for testing single mode fiber systems and LED sources at 850 / 1300 nm used for testing multimode fiber systems.
The 1300 nm LED can also perform short distance single mode testing. The 660 nm LED source option is ideal for POF testing in combination with KI9600 XL power meter.

Light source features re-connection repeatability of 0.1dB; combined with the instrument excellent stability, this provides more accurate measurement results.

GENERAL SAFETY SUMMARY

The following safety signs and symbols specify general safety precautions which must be observed during all phases of operation, service and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture and intended use of the instrument. Kingfisher International assumes no liability for the customer's failure to comply with these requirements.

Before operation, review the instrument and user manual for safety instructions. You must follow these to ensure safe operation and to maintain the instrument in safe condition.

WARNING!

The **WARNING!** sign denotes a hazard. It calls attention to a procedure, practice or the like, which, if not correctly performed or adhered to, could result in injury. Do not proceed beyond a **WARNING!** sign until the indicated safety conditions are fully understood and met.

CAUTION!

The **CAUTION!** sign denotes a hazard. It calls attention to an operating procedure, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part, or all, of the product. Do not proceed beyond a **CAUTION!** sign until the indicated conditions are fully understood and met.

Safety Symbols

The apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the apparatus against damage.

Initial Inspection

Inspect the shipping container for damage. If there is damage to the container or cushioning, keep them until you have checked the contents of the shipment for completeness and verified the instrument both mechanically and electrically. If the contents are incomplete, mechanical damage or defect is apparent, or if an instrument does not pass the operator's checks, notify the nearest Sales/Service Office.
To check instrument performance, please refer to **Performance Verification Tests** section of this manual.

WARNING! You must return instruments with malfunctions to a Service Centre for repair and calibration.

Operating Environment

The range of Kingfisher equipment covered by this manual can be operated at temperatures between -15 °C and +55 °C and at relative humidity of <95 %.

Storage and Shipment

The range of Kingfisher equipment covered by this manual can be stored or shipped at temperatures between -25 °C and +70 °C and at relative humidity of less than 95 %. Protect the unit from temperature extremes that may cause condensation within it.

Safety

This instrument contains no hazardous optical or electrical items. When using this equipment, optical safety precautions should be observed commensurate with the maximum available source power, since most of this power can also be coupled out of the instrument.

WARNING! Observe optical safety when using high power.

Optical safety requirements at high power levels **MUST** be observed or eye damage is likely. Organisations and users operating optical equipment with these power levels **MUST** determine and observe relevant safety precautions, which are beyond the scope of this manual.

Laser and LED Safety Information

Visual laser	635 ± 5 nm
VCSEL	850 ± 20 nm
Surface emitting LED	refer current specifications
InGaAs Fabry - Perot laser	1310/1490/1550 ± 20 nm
Max CW output power[1]	
635 nm	0.631 mW
850 nm	0.631 mW
1310/1490/1550 nm	1.26 mW
Laser Class according to	
IEC 60825-1 (2001) – International	
635 nm	class 2
850 nm	class 1
1310/1490/1550 nm	class 1
21 CFR 1040.10 (1995) – USA	
635 nm	class 2
850 nm	class 1
1310/1490/1550 nm	class 1
Maximum permissible CW output power[2]	
IEC 60825-1 (2001) - International	
635 nm, class 2	1mW
850 nm, class 1	0.78 mW
1310 nm, class 1	15.6 mW
1490/1550 nm, class 1	10 mW
21 CFR 1040.10 (1995) – USA	
635 nm, Class 2	1mW
850 nm, Class 1	0.76 mW
1310 nm, Class 1	2 mW
1490/1550 nm, Class 1	8.1mW

Note 1: Maximum CW output power is defined as the highest possible optical power that the Source can produce at its output connector. Refer to specification sheet for actual operating power

Note 2: Maximum permissible CW output power is the highest optical power that is permitted within the appropriate laser class. Refer to specification sheet for actual operating power

In the USA, laser / LED sources specified by this data sheet are classified as Class 1 and Class 2 according to 21 CFR 1040.10 (1995). Internationally, the same laser sources are classified as Class 1 and Class 2 according to IEC 60825-1 (2001).

WARNING!

Optical power levels in fiber optic systems can cause permanent eye injury and damage to eyesight.

Never look into the end of an optical cable or connector which might be attached to an active source.

Do not enable a laser when there is no fibre attached to the optical output connector. Optical magnifying instruments (eg microscope) increase eye hazard. Disconnect the source before using an optical magnifier. The laser module has a built-in safety circuitry which will disable the optical output in the case of a fault condition, however,

this cannot be guaranteed. An equipment assurance program is recommended to check for safe laser operation.

BATTERY POWER

These instruments are powered by two 1.5 V dry alkaline 'AAA' size batteries. Alternatively, use re-chargeable NiCad or NiMH batteries:

Model	Battery run time in hours
KI 9600 Optical Power Meter	300
KI 9800 Optical Light Source	25

When the batteries are low, the low battery indicator is shown on the display. At this stage, there is approximately enough energy for another 20 hours of use.

To save energy, the instrument automatically turns off after 10 minutes without operation.

To change the batteries, open the cover of the battery compartment at the side of the instrument, remove the batteries and insert new ones.

CAUTION!

Do not use lithium batteries or other batteries with a nominal voltage greater than 1.8 V. The instrument may be damaged.

Protect our environment! Batteries purchased from Kingfisher agents can be returned to them for appropriate disposal.

OPTICAL CONNECTOR

To access the optical connector, grasp the top left corner of the instrument, and pull off the cover.

To install an adaptor, align the locating slot on the side of the through adaptor with that on the instrument connector, and press it on.

To remove an adaptor, press button on the front of the instrument and then pull off the adaptor. It is easier to pull off the adaptor with a test lead in place, since this gives better grip.

Different styles of connector adaptor (ST, SC, FC, MU, LC/F3000, E2000/LSH, D4, MU, 2.5mm universal, SMA and LSA/DIN) can be easily fitted by the user.

When not in use, keep the test port and connector covered. Do not touch connector tip with your fingers, since body oils and dirt can impair connector performance.

The supplied standard adaptors have ceramic sleeves and do not cause metal dust contamination, which can cause connector failure and fiber fuse at very high power levels.

CAUTION! Do not use damaged or incompatible connectors.

Power Meter

Power meter can be used with **both** PC **and** APC connector styles.

Bare fiber adaptors must achieve fiber eccentricity of ± 100 microns, and end tolerance of ± 300 microns relative to the ferrule end. Preferred bare fiber adaptors consist of a connector with fiber retention device or other end stop.

For regular work with bare fibers, it is preferable to use an alternative arrangement such as a multimode pigtail with a v-groove or mechanical splice.

CAUTION! Do not scratch the detector lens with the glass fiber end when using bare fiber adaptors.

Light Source

A light source is **either** PC **or** APC connector specific. This is determined when ordering the instrument.

CAUTION! The use of bare fiber adaptors is not recommended as permanent instrument damage will occur

How to clean the optical connectors

Always clean the mating connector tip and ferrule before mating, using approved materials.

CAUTION! Do not attempt to clean an optical interface with anything hard that could scratch glass, or permanent instrument damage may occur.

Power Meter

The glass power meter interface does not make contact with the inserted connector - there is a slight air gap. Therefore it will not wear, and only needs occasional cleaning. To clean, first remove the connector adaptor to access the glass interface, then use a soft brush, alcohol, air can or sticky material such as 'Blu tac'to remove dirt.

OPTICAL CONNECTOR

Light Source

WARNING! Disable source when cleaning optical interface. Remove batteries before using a microscope to inspect instrument connector.

To clean the interface, use stick style connector cleaner and blow away any dust or dirt with compressed air. If this is not sufficient, clean the interface by rubbing a lint-free lens cloth over the surface using small circular movements.

OPERATION

To switch on KI 9000 instruments for permanent operation, press and hold [POWER] during turn-on. The display will briefly show firmware version. 'Perm' on the display indicates that the unit will stay on permanently. Should the instrument fail to turn on, the microprocessor may need re-booting. To do this, remove the batteries for at least 40 seconds.

Power Meter

After turn-on, the instrument performs a self-calibration sequence, and then displays absolute power in dBm at the previously set wavelength. If 'HI' or 'LO' are displayed, the input is out of range.

The mode of operation described below is typically used to measure Tx / Rx absolute power levels and to perform continuity testing with the tone detector. To measure the operational power level in a fiber optic system, the meter is used in dBm or linear modes. To measure optical loss or attenuation, the power meter is used in dB mode, and the source power is taken as a reference.

WARNING! Observe optical safety procedures relevant to the power levels being measured.

- During instrument turn on:
  - to view all display segments, press and hold down [λ ◂]
  - to display firmware version, press and hold down [HOLD]
  - to turn buzzer on/off, press and hold down [▸ λ]
- To scroll wavelength, press [λ ◂] or [▸ λ]. The display shows the nominal wavelength in nm on the top right of the display.
- To toggle logarithmic / relative/ linear display modes, press [dB/dBm/mW]. The display will show 'dB' or 'dBm' or 'nW'.
- To stop / start display update, press [Hold]. The symbol will flash when the display is on hold.
- To set reference, press and hold [Set Ref] for more than 3 sec.
- When in reference mode, the reference value is displayed on the left hand side of the display.
- To display max min recorded power or to re-set this function, press and hold [Max Min].
- If the meter detects a test tone higher than 200 Hz, the display will show the actual measured modulation frequency in kHz.
- Maximum displayed frequency is 2500 Hz.
- If a standard tone is detected (eg 270 Hz, 1 KHz, 2 KHz), a buzzer will sound. This is useful for fiber identification and signalling. The meter can also be used to check the actual modulation frequency of test sources.

Light Source

The mode of operation described below is typically used to perform continuity testing with the test tone generator.

The light source may require a warm up period at the set wavelength for 15 min to achieve specified stability (ORL< 25dB).

- During instrument turn on:
  - to view all display segments, press and hold down [λ ◂].
  - to display firmware version, press and hold down [LEVEL].
  - to turn buzzer off, press and hold down [▸ λ].
- After instrument is turned on, the display shows 'OFF'. To enable source emitter, press [λ ◂] or [▸ λ].Operating wavelengths will be shown in the top corner on the right hand side and source power level on the left hand side.
- To scroll wavelength, press [λ ◂] or [▸ λ].

  WARNING! Do not enable a laser when there is no fibre attached to the optical output connector.
- To modulate the source, press [AUTO MOD]. Modulation is active only while the source is enabled. To select a modulation frequency, press [AUTO MOD] to scroll through available settings: 0.27 KHz, 1 kHz, 2 kHz to On (CW) and for 660 nm LED, 2 Hz.

Laser Output Power Adjustment

To adjust the laser output power, turn the laser 'on', then press [LEVEL] to decrease the output power. To set to factory default, press and hold [LEVEL] for 3 sec.

Note: This function is not available on the LED source option

CARE OF YOUR INSTRUMENT

Follow the directions in this manual on optical connector care.

- Use only high quality sealed alkaline or NiMH or NiCad batteries.
- During prolonged storage, remove batteries to eliminate the possibility of acid leakage.
- During storage and transport, keep the instrument in its carry case to protect against crushing, vibration, dust and moisture.
- The instrument is resistant to normal dust and moisture, however it is not waterproof. If moisture gets into the instrument, dry it out carefully before using it again.
- Where possible, keep instrument away from direct sunlight.
- Clean the instrument case using alcohol or other non solvent cleaning agents. Acetone or other active solvents may damage the case.
- The instrument housing is made of tough polycarbonate material with impact absorbing rubberised sides and corner features and is therefore drop resistant.

Power Meter

- Input optical power must not exceed the damage level specified for each detector type.

ACCURACY CONSIDERATIONS

All Measurements

Keep optical connectors clean and in good condition. APC connectors will generally provide improved power stability on single mode systems.

To reduce the effect of polarisation changes, test leads should be neat, coiled and physically stable.

In multimode systems, modal noise and general uncertainty are much worse than in single mode systems and optimum measurement repeatability will be obtained by use of a mandrel wrap.

Wavelength uncertainty affects power meter calibration. This is significant with a Ge detector in the 1550 nm band (eg > 1560 nm in cold weather).

For general measuring from 660 to 1550 nm, the Ge meters offer adequate accuracy.
For better accuracy or linearity, or wavelengths above 1550 nm, the InGaAs meter is preferred.

For high power testing, the H series meters offer excellent accuracy, power handling, wavelength and connector reflections insensitivity.

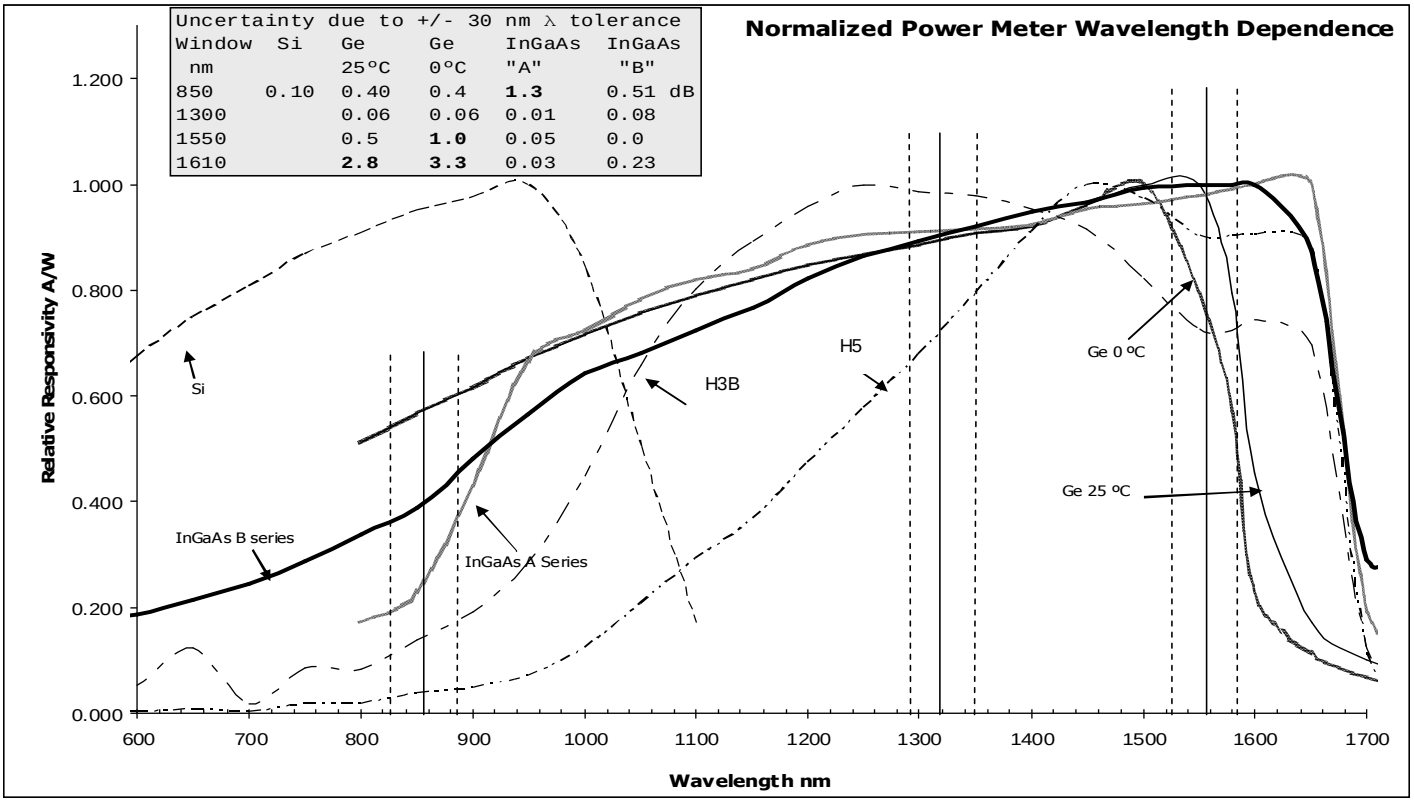
For PON testing, the Wavelength Selective meter KI9600WS01-Ge offers a simple way to measure 1550 nm light, unaffected by other wavelengths.
Light source power may drift. When you have finished a test, go back to the start position to check if the light source power is still within acceptable limits. Specifications are for typical drift, warm up, and with a specified level of return loss. Actual drift will vary between instruments and test situations.

Most available laser sources are sensitive to reflections. Varying reflections can induce laser source instability of around 0.3 dB. This is very difficult to verify without a special test system, but can cause errors. Reduced reflection will result in improved repeatability.

Due to emitter centre wavelength uncertainty (eg ± 20 nm), fiber attenuation may vary with different light sources.

ACCURACY CONSIDERATIONS

Uncertainty due to +/- 30 nm λ tolerance					
Window nm	Si	Ge 25°C	Ge 0°C	InGaAs "A"	InGaAs "B"
850	0.10	0.40	0.4	**1.3**	0.51 dB
1300		0.06	0.06	0.01	0.08
1550		0.5	**1.0**	0.05	0.0
1610		**2.8**	**3.3**	0.03	0.23



Power Meter

Power Range: the range of input powers for which the instrument can be used.

Maximum Input Power: the input power not to be exceeded to avoid destroying the instrument.

Uncertainty at Reference Conditions: the uncertainty for the specified set of reference conditions, which includes all uncertainties in the calibration chain, from the national laboratory to the test meter (connectors and test leads must be absolutely clean and undamaged). Reference conditions are the conditions during the responsivity calibration.

Total Uncertainty: the uncertainty for a specified set of operating conditions which includes noise and drift (connectors and test leads must be absolutely clean and undamaged).

Light Source

Output Power: the CW output power at the specified wavelength at the end of a reference cable.

Power Uncertainty / Repeatability: the uncertainty in power level at the end of a reference cable.

Short / Long Term (Power) Stability: in CW mode, the uncertainty of the power level observed over a given time, compared to the mean power during this time. Measured with an averaging optical power meter, a 9/125 or 62.5 µm fiber, at constant temperature, and within a specified temperature window.

Centre wavelength: the wavelength representing the centre of mass of the selected peaks**:**

$$\lambda_{cw} = (1/P_o)\Sigma(P_i \lambda_i)$$

where P_i and λ_i are the power and wavelength of each spectral component and P_o is the total power.

Spectral Bandwidth: FWHM (full width at half the maximum), describes the spectral width of the half-power points of the laser, assuming a Gaussian envelope of the spectral power distribution. The half-power points are those where the power-spectral density is one half of the peak amplitude of the Gaussian curve:

$$\Delta\lambda_{RMS} = \left(\frac{\Sigma P_i \lambda_i^2}{P_{total}} - \lambda_{center}^2 \right)^{1/2}$$

and

$$\Delta\lambda_{FWHM} = M \Delta\lambda_{RMS}$$

where: λ_{center} = center wavelength of laser diode (in vacuum)
P_{total} = ΣP_i = total power, in watts
P_i = power of i^{th} longitudinal mode
λ_i = wavelength of i^{th} longitudinal mode (in vacuum)
M = multiplication factor; for a source with a Gaussian envelope $M = 2.35$; for other types of spectra, use $M = 2.35$ as well.

SPECIFICATIONS

General Specifications:

Size:	124 x 81 x 25 mm, 4.9" x 3.2" x 1"
Weight:	150 gm, 0.3 lb
Power Meter XL Series	160 gm, 0.4 lb
	Shipping 0.5 Kg, 1.1 lb.
Operating/ Storage:	-15 to 55 °C / -25 to 70 °C.
Power:	2 alkaline 'AAA' cells
Case:	Polycarbonate, 2.5 meter drop tested.
Calibration:	Performed without opening instrument. Recommended calibration cycle: 3 years.
Display:	4 digit high contrast LCD Linear: 3 digits (100-999) or 0.01 nW
Power Meter:	
Tone detection:	200~ 2500 Hz ±2%.

SPECIFICATIONS

KI 9800 Optical Light Source:

	1310/1550 nm Laser	1310/1490/1550 nm Laser	635 nm Laser	850 nm VCSEL	850 / 1300 nm LED	660 nm LED	Comments
Output Power, dBm/ Fiber Type, µm	0 @ 9/125	-4 @ 9/125	-2 @ 9/125	-0 @ 50/125	-23 @ 62.5/125 -35 @ 9.5/125	-6 @ 1000 POF	± 1 dB
Short term stability, dB	0.04[1]	0.06[1]	N/A	0.12[1]	0.01	0.01	For 15 min, typ ± Δ 2°C, after warm up
Stability over temp, dB	0.6	0.6	N/A	0.8	0.35	0.35	Typical, over temperature
λ initial tolerance, nm	20	20	5	20	±25 @ 850 N/A	5	At 25 °C
λ width, nm	3	< 1	3	< 1			FWHM, typical
λ nm/°C	0.4	0.1	0.1	0.1	0.4	NA	Typical
Mode Controlled Source	NA	NA	NA	Mode controlled[2]		NA	
Reconnection repeatability, dB	0.1				0.05	NA	95 % confidence
Modulation	270 Hz, 1 kHz, 2 kHz ± 2 %						
Blinking 2 Hz	NA			Yes	NA	Yes	
Laser output	Adjustable over 3 dB in 0.1 dB steps						

1) ORL < -25 dB.

2) Multimode source: mode distribution @ 50/125 is compliant with the following standards: IEC 61280-4-1 {Ed.1.0}, TIA/EIA 526-14A and TIA TSB-178.

SPECIFICATIONS

KI 9600 Series Optical Power Meter

Detector type	Response λ nm	Damage level dBm	Calibration λ nm	Power range dBm	Mid range linearity[1] dB	Calibration Accuracy[2] %	Polarisation Sensitivity dB	Total Uncertainty[3] dB	λ Sensitivity[5] ± 30 nm dB
Ge	600 ~ 1650	+15	*660,* ***850*** **1300,1310,1390, 1490,1550,1610,1625**	*+10 ~ -60*	0.04	2 %	< 0.005	0.5	0.04
InGaAs	600 ~ 1700	+15	*660,* ***850*** **1300, 1310, 1390, 1490, 1550, 1610, 1625**	*+5 ~ -60*	0.02	2 %	< 0.005	0.3	0. 03
H3B (InGaAs)	800 ~ 1700	+27[4]	*850* **1300, 1310, 1390, 1490, 1550,1590, 1610, 1625**	+24 ~ -40	0.02	2 %	< 0.005	0.3	0. 03
H5 (InGaAs)	800 ~ 1700	+25	*850* **1300, 1310, 1390, 1490, 1550,1590, 1610, 1625**	*+15 ~ -50*	0.02	2 %	< 0.005	0.3	0. 03
					typical		*typical*	*max*	*typical*

SPECIFICATIONS

KI9600WS01-Ge

Calibrated wavelengths(nm)	1550
Measurement of 1550nm	
Pass band	1530 to 1625
Isolation of 1490nm band	> 25dB
Isolation of 1310nm band	> 30dB
Max permitted input level	+15dBm
Measurement range	+10 to -70 dBm
Measurement accuracy	
Mid range linearity[1]	0.04 dB
Polarization sensitivity	< 0.005 dB
Total Uncertainty[3]	0.5 dB

Note 1: Mid range linearity excludes top 3 dB and bottom 10 dB of range.

Note 2: Calibration condition: non coherent light, -35 ± 5 dBm, 23 ± 1°C, ± 1 nm, 10 ± 3 nm FWHM, PC ceramic connector, 100 µm fiber

Note 3: Includes contributions due to: varying optical connector types, calibration uncertainty, full temperature, dynamic range and fiber core diameter up to 200 µm.

Note 4: H3B can sustain the damage level for 2 minutes.

Note 5: At calibration wavelengths in bold type

KI 9600XL Series Large Area Optical Power Meter

Detector type	Response λ nm	Damage level dBm	Calibration λ nm	Power range dBm	Mid range linearity[1] dB	Calibration Accuracy[2] %	Polarisation Sensitivity dB	Total Uncertainty[3] dB	λ Sensitivity[5] ± 30 nm dB
5mm Ge	600 ~ 1650	+15	***780, 850*** **1300, 1310,** **1490,** 1550, 1625	*+10 ~ -35* *+10 ~ -40*	0.04	2 %	< 0.005	0.5	0.04
5 mm Si	350 ~ 1100	+10	***470, 520,*** ***635,*** **650, 660, 780, 850, 980**	*+5 ~ -60*	0.02	2 %	< 0.005	0.3	0. 03
					typical		*typical*	*max*	*typical*

ORDERING INFORMATION

KI 9600 Series Optical Power Meter:

Ge Power Meter	KI 9600B - Ge
InGaAs Power Meter	KI 9600B - InGaAs
H3B (InGaAs) Power Meter	KI 9600B - H3B
H5 (InGaAs) Power Meter	KI 9600B - H5
1550 nm Ge Power Meter	KI 9600WS01

Standard Accessories:

ST, SC, FC connector adaptors, User manual on CD, NATA (ILAC) traceable calibration certificate, carry strap, soft carry pouch.

Optical Connectors:

The power meter works with both PC and APC connectors.

Optional Interchangeable Connector Adaptors:

Description	P/N	Description	P/N
D4	**OPT055**	LC/F3000	**OPT072**
E2000/LSH, blue	**OPT060**	MU	**OPT080**
E2000/LSH, green	**OPT060G**	Universal 2.5mm	**OPT081**
LSA/DIN 47256 blue	**OPT071**	SMA 905/906	**OPT082**

KI 9600XL Series Large Area Optical Power Meter:

Large Area Ge Power Meter	KI 9600XL – Ge 5
Large Area Si Power Meter	KI 9600XL – Si 5

Standard Accessories:

User manual on CD, NATA (ILAC) traceable calibration certificate, carry strap, soft carry pouch.

Optional Interchangeable Connector Adaptors:

Description	P/N	Description	P/N
ST	**OPT202**	FC	**OPT204**
SC	**OPT201**	LSA/DIN	**OPT207**
E2000/LSH	**OPT220**	SMA905/906	**OPT203**
D4	**OPT206**	EC	**OPT221**
MU	**OPT222**	MTRJ	**OPT223**
Biconic	**OPT205**	Diamond 3.5mm	**OPT208**
Universal 1.25mm	**OPT224**	Universal 2.5mm	**OPT225**

To order KI9600XL Series Large Area Optical Power Meter, please specify instrument and at least one optional interchangeable connector adaptor.

ORDERING INFORMATION

KI 9800 Series Optical Light Source:

VFL, 635 laser	KI9807
VFL, 635 laser, APC	KI9807 - APC
660 nm LED, 1mm POF, fixed SMA	KI 9809
850 nm LED	KI 9810
850-1300 nm LED	KI 9812
850 nm LED	KI 9820
1310/1550 nm laser	KI 9822
1310/1550 nm laser, APC	KI 9822 - APC
1310/1490/1550 nm laser	KI 9827
1310/1490/1550 nm laser, APC	KI 9827 - APC
850 nm VCSEL	KI 9840

Standard Accessories:

ST, SC, FC connector adaptors, User manual on CD, NATA (ILAC) traceable calibration certificate, carry strap, soft carry pouch, 50µm and 62.5µm mandrel wraps (LED source only).

Optical Connectors: The source ferrule type is fixed and customer specified as either PC or APC when ordering the instrument.

Optional Interchangeable Connector Adaptors:

Description	P/N	Description	P/N
D4	**OPT055**	LC/F3000	**OPT072**
E2000/LSH, blue	**OPT060**	MU	**OPT080**
E2000/LSH, green	**OPT060G**	SMA 905/906	**OPT082**
LSA/DIN 47256 blue	**OPT071**		

Optional Tests:

Traceable test, 50µm, CPR per IEC14763-3.Option includes 50 µm mandrel wrap.	**OPT094**
Traceable test, 62.5µm, CPR per IEC14763-3.Option includes 62.5 µm mandrel wrap.	**OPT095**

CALIBRATION AND MAINTENANCE

There are no internal user adjustments. Calibration is performed without opening the instrument.

Before commencing calibration:

- Clean all optical connectors very carefully.
- Ensure that all devices have been at a stable room temperature for over an hour, and that the light source is fully warmed up at the wavelength to be calibrated.
- Ensure that all installed batteries are in good working condition.

To enable calibration mode, remove belt clip and anti-tamper label at the back of the instrument and insert a 2.54 mm (0.1") pitch programming shunt across pins. Manipulation of the shunt is easier with needle nose pliers.

Figure1. Calibration opening, positioned at the back of the instrument underneath belt clip and covered by anti-temper label.

Perform calibration as per instructions below. When calibration is complete, remove the calibration shunt, and place an anti-tamper label over the hole. Do not forget to update your calibration records and to schedule the next calibration service.

Power Meter Calibration

Calibration is a transfer process. It is performed by setting up a light source at a stable, but non-critical power level between 0 and -30 dBm, and adjusting the meter reading to the same value as that shown by a reference meter.

Required are laser and LED light sources with accurate, calibrated wavelengths and good power stability, a power meter with appropriate calibrated wavelengths, single mode and multimode test leads. Check the calibration certificates on your reference equipment to ensure current validity.

Known calibration constants can be re-entered directly without using other equipment. This is useful in case old calibration constants are to be put back.

Record the existing calibration offsets, re-enter or adjust known offsets at this point or calibrate the meter at the selected wavelength as follows:

- Inserting the 2.54 mm (0.1") pitch programming shunt across pins will put the instrument into calibration mode. It will display 'CAL'.
- Press [λ ◂] or [▸ λ] to set the wavelength to be calibrated.
- Record the light source power measured by reference power meter.
- Transfer this power level to the meter to be calibrated:

  Press [HOLD] to display power reading. Press [HOLD] again to display current offsets. Record the current (old) value. Press [HOLD] again, then [λ ◂] or [▸ λ] to adjust reading to match the noted reference reading. Press [HOLD] again to display current offsets. Record the current (new) value.

  Note: Toggling the [HOLD] button will show the power reading and the offsets on the display.
- To set the new value, press and hold [dB/dBm/ mW] until the instrument beeps. The display will show 'CAL' and calibrated wavelength.
- Repeat above process for other wavelengths.

Light Source Calibration

The emitter power level can be re-calibrated, and the current checked.

Required are reference power meter with appropriate calibrated wavelengths, single mode and multimode test leads, an anti-tamper label. Check the calibration certificates on your reference equipment to ensure current validity.

CAUTION! Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Calibrate the source at the selected wavelengths as follows:

- Inserting the 2.54 mm (0.1") pitch programming shunt across pins will put the instrument into calibration mode. It will display 'CAL'.
- Press [λ◄] to set the wavelength to be calibrated. Measure light source power using the reference meter.
- Press [►λ] to display DAC values from 0 to 1023 and emitter current.
- Set the emitter power to the required level by pressing [AUTO MOD] to reduce and [LEVEL] to increase output.
- Press [λ◄] to save new value and to exit.
- To return to factory default setting, press [λ◄].
- Repeat the above process for any additional wavelengths if required.

Opening the Instrument:

CAUTION!

- Do not open unless warranty has expired and you are authorised to do so. Opening the unit will invalidate any warranty claim.
- This unit contains static sensitive devices. Anti-static handling procedures should be observed at all times when handling internal circuits.
- There are no internal user adjustments. All calibration is performed without opening the instrument. The optical sensor / connector assembly is not user serviceable.

Procedure:

- Open battery compartment and remove the batteries. Pull open the optical connector cover.
- Place the instrument face down on a soft mat, remove belt clip and undo the screws in the rear housing. The instrument can now be gently pulled apart.
- Further disassembly from this stage should be easily apparent to a technician.
- Re-assembly is the reverse of the previous procedure.

PERFORMANCE VERIFICATION TESTS

The tests procedures described in this section are for performance verification of a KI9600B-InGaAs Optical Power Meter and KI9822 Optical Light Source.

It is not possible to give detailed test procedures for all instrument options, so some parameters may need adjusting to the appropriate specifications.

Required Equipment: this is the required equipment for the performance tests listed. Any equipment that satisfies the critical specifications of the equipment given in the table may be substituted for the recommended models.

Test Record: results of the performance test may be tabulated on a photocopy of the Test Record provided at the end of the test procedure. It is recommended that you fill out the Test Record and refer to it while doing the test. Alternatively, a soft copy of this manual may be obtained from our web site.

Test Failure: if the equipment under test fails any performance test, return the instrument to the nearest Sales/Service Office for repair.

Instrument Specification: specifications are the performance characteristics of the instrument that are certified, and are the limits against which the equipment under test can be tested.

Any changes in the specifications due to manufacturing changes, design, or traceability to NATA, will be covered in a manual change supplement, or revised manual. Such specifications supersede any previously published.

General Instructions

Perform each step in the order given, using the corresponding test equipment. Use Tables 1 ~ 3 to record general test details.

The SMF / MMF test lead fiber type and PC / APC connector polish must be matched to the instrument type.

Ensure that all optical connections are dry and clean. **DO NOT USE INDEX MATCHING OIL**. For cleaning, use the cleaning instructions given in the section 'Optical Connector'.

Make sure that all patch cords are fixed to the table to avoid movements during measurements.

Ensure that the ambient conditions are in the following ranges:

Temperature: 21 ± 3 ºC

Relative humidity: 45 to 75 %

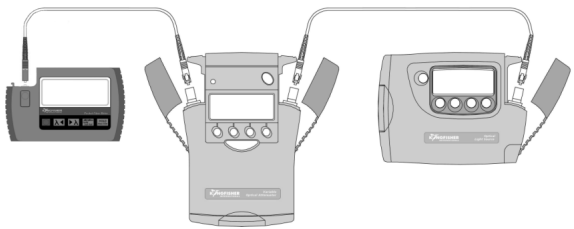
Instrument / Accessory	Recommended Model	Required Characteristics	Alternative Model
Optical Light Source	KI3822B		KI7400, KI7800, KI7300A, KI9800
Optical Power Meter	KI3600-InGaAs		KI7600B, KI9600
Optical Attenuator	KI7011B		KI7010A
For optional test only			
Optical Spectrum Analyzer	71450B		71452B (8164xA,B)

Table 1. Required Equipment for KI 9600 and KI 9800 Performance Verification Tests.

Optical Power Meter

Accuracy Test

1. Connect the equipment as shown in Figure 2:



Power Meter **Attenuator** **Light Source**

Figure 2.Test set-up for KI 9600 Power Meter Accuracy Test

2. Switch on all three instruments.
3. Set all instruments to 1310 nm.
4. Change the attenuation of attenuator until the optical power meter displays -10.00 dBm. Note the attenuator setting in setting 1 of Table 4.

   If the laser source is not powerful enough to give -10 dBm, set the attenuator to 2.5 dB and correct the appropriate values in the test report.

   Repeat the above for reference power meter readings of -20dBm, -30 dBm, -40 dBm and -50 dBm (settings 2 ~ 5).
5. Measure the DUT:

   Re-connect the attenuator output cable to the DUT.

   Set the attenuator to its value for setting 1.

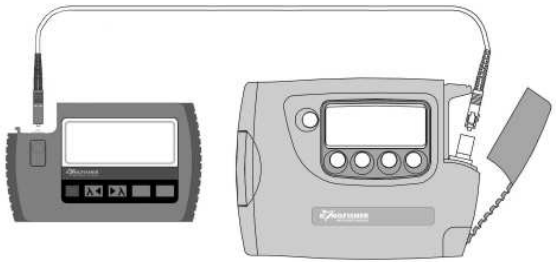
   Note the displayed power level of the DUT in the test record.

   Repeat the above for attenuator settings 2 ~ 5.
6. Repeat the Power Meter Accuracy Test at 1550 nm.

Optical Light Source

Output Power (CW) Test

1. Connect the equipment as shown in Figure 3.
2. Switch on the instruments.
3. Set the Optical Power Meter to 1310 nm
4. On Light Source, enable the source and set the wavelength to 1310 nm.
5. Note the measured power level value in the test report in Table 5.
6. Repeat the above on 1550 nm.



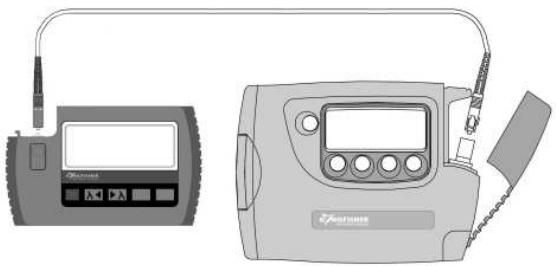
Light Source **Power Meter**

Figure 3. Test set-up for KI 9800 Light Source Output Power (CW) Test

Optical Light Source

Short Term Stability Test (optional)

1. Connect the equipment as shown in Figure 4. For better stability, ensure that connector plugged into power meter has APC termination.



Light Source **Power Meter**

Figure 4. Test set-up for KI 9800 Light Source Short Term Stability Test

2. Set the optical power meter to 1310 nm.

3. On Light Source, enable the source and set the wavelength to 1310 nm.

4. Let the unit warm-up for 15 minutes then note the power.

5. Record the power every 30 seconds for 3 minutes.

6. Calculate max-min values for stability (< 0.1dB).

7. Record test results in Table 5.

Time	Measured power, dBm	Drift, dB	Tick max/min values
00 sec		0.00	
30 sec			
60 sec			
90 sec			
120 sec			
150 sec			
180 sec			

Optical Light Source

Centre wavelength and Spectral Bandwidth (FWHM) Test (optional)

1. Connect the equipment as shown in Figure 5.

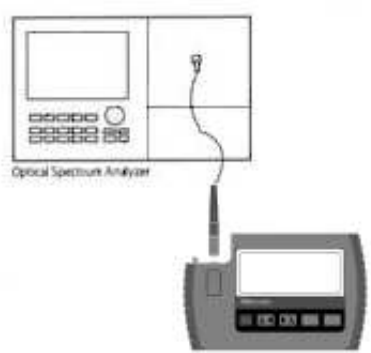


Figure 5. Test set-up for the centre wavelength and spectral bandwidth

2. Switch on the instruments and allow to fully warm up.

3. On Light Source, enable the source and set the wavelength to 1310 nm.

4. On the OSA, press the [Instr Preset] key

5. Press [Auto/Meas] and wait until 'End of Automeasure' is displayed

6. Choose [User] and select the type of source to be measured (FP for Fabry Perot laser).

7. To show the display in linear mode:

   - Press [Menu].
   - Press [Amptd] on the left side of the display.
   - Press [Linear] on the right side of the display.

8. To ensure interference - free reading of the display it is advisable to stop the repeating calculations.

   - Press [User].
   - Press [Single Sweep].

   If the trace on the display is not clear, you can change resolution by using the span key.

9. From the displayed measurements check and note the values for "mean wavelength" (Centre wavelength) and "FWHM" (Spectral Bandwidth) in the test report, Table 6.

10. Repeat the test with the source wavelength set to 1550 nm.

PERFORMANCE VERIFICATION TESTS

Model:	Date:
Serial No.:	Ambient Temperature: °C
Options:	Relative Humidity: %
Firmware Revision:	Line Frequency: Hz
Test Facility:	Customer:
Performed by:	Report No:
Special Notes:	

Table 2. General Test Record for KI 9600 and KI 9800

PERFORMANCE VERIFICATION TESTS

Description		Model	Trace No.	Calibration Due Date
1.	Optical Light Source			
2.	Optical Power Meter			
3.	Optical Attenuator			
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Accessories
Singlemode Fiber
Connector Adaptors

Table 3. Equipment Record for KI 9600 and KI 9800 Performance Verification Tests.

Model: _____ **Report No:** _____ **Date:** _____

Accuracy Test					
	Test Wavelength =				
Setting Number	Power meter Reference value	Attenuator Setting	Minimum Specification (-0.3 dB of Reference)	DUT Measurement results	Maximum Specification (+0.3 dB of Reference.)
1.	(~- 10.00 dBm)	_____ dB	(~- 10.30 dBm)	_____ dBm	(~- 9.70 dBm)
2.	(~- 20.00 dBm)	_____ dB	(~- 20.30 dBm)	_____ dBm	(~- 19.70 dBm)
3.	(~- 30.00 dBm)	_____ dB	(~- 30.30 dBm)	_____ dBm	(~- 29.70 dBm)
4.	(~- 40.00 dBm)	_____ dB	(~- 40.30 dBm)	_____ dBm	(~- 39.70 dBm)
5.	(~- 50.00 dBm)	_____ dB	(~- 50.30 dBm)	_____ dBm	(~- 49.70 dBm)
		_____		_____	
		Measurement Uncertainty		_____ dB	

Note 1: Minimum/Maximum Specification is for the KI 9600-InGaAs. For the KI 9600-Ge, increase/reduce by ±0.2 dB. For the KI 9600-H3B, increase/reduce by ± 0.1 dB.

Table 4. Accuracy Test Record for KI 9600 Series Optical Power Meter

Model:	Report No.		Date:	

Output Power (CW) Test

Wavelength	Minimum Specification	DUT Measurement Results	Maximum Specification
1310 nm	-1.00 dBm	_____ dBm	
1550 nm	-1.00 dBm	_____ dBm	
Measurement Uncertainty		_____ dB	

Short-Term Stability Test (optional)

1310 nm		_____ dBpp	(0.10 dBpp) 0.04 dBpp typical
1550 nm		_____ dBpp	(0.10 dBpp) 0.04 dBpp typical
Measurement Uncertainty		_____ dB	

Table 5. Output Power Test and Short Term Stability Test Record for KI 9800 Series Optical Light Source

Model:		Report No:		Date:	

Central Wavelength & Spectral Bandwidth (FWHM) Test (optional)

Wavelength	Minimum Spec.	DUT Measurement Results		Maximum Spec.
Centre wavelength				
1310 nm	1290 nm	_____	nm	1330 nm
1550 nm	1530 nm	_____	nm	1570 nm
Spectral Bandwidth (FWHM)				
1310 nm		_____	nm	(6nm) 3 nm typical
1550 nm		_____	nm	(6nm) 3 nm typical
Measurement Uncertainty		_____	dB	

Table 6. Central wavelength and Test Record for KI 9800 Series Optical Light Source

- To remove interchangeable connector adaptor, press the button on the front of the instrument and pull off adaptor.
- To defeat auto power-off, press and hold [POWER] for 3 seconds during turn on. 'Perm' is displayed on the top right of the LCD.
- Low battery is indicated with a battery symbol.
- During instrument turn on:
  - to view all display segments, press and hold [λ ◂]
  - to turn buzzer on/off, press and hold [▸ λ]
  - to display firmware version, press [HOLD]
- To scroll wavelength, press [λ ◂] or [▸ λ].
- To switch between logarithmic/relative/linear display modes, press [dB/dBm/mW].
- To stop / start display update, press [HOLD].
- To set reference, press and hold [Set Ref] for more than 3 sec.
- To display max min recorded power press and hold [Max Min]. To re-set this function, press [POWER].
- If the meter detects a test tone higher than 200 Hz, the display will show the actual measured modulation frequency in kHz.
- If a standard tone is detected (eg 270 Hz, 1 KHz, 2 KHz), a buzzer will sound.

- To remove interchangeable connector adaptor, press the button on the front of the instrument and pull off adaptor.
- To defeat auto power-off, press and hold [POWER] for 3 seconds during turn on. 'Perm' is displayed on the top right of the LCD.
- Low battery is indicated with a battery symbol.
- During instrument turn on:
  - to view all display segments, press and hold down [λ ◂].
  - to display firmware version, press and hold down [LEVEL].
  - to turn buzzer off, press and hold down [▸ λ].
- To enable source emitter, press [λ ◂] or [▸ λ] after turning on instrument. Operating wavelengths will be shown in the top corner on the right hand side and source power level on the left hand side.
- To scroll wavelength, press [λ ◂] or [▸ λ].
- To modulate the source, press [AUTO MOD]. Modulation is active only while the source is enabled. To select a modulation frequency, press [AUTO MOD] to scroll through available settings: 0.27 KHz, 1 kHz, 2 kHz to On (CW) and for 660 nm LED, 2 Hz.

Laser Output Power Adjustment

To adjust the laser output power, turn the laser 'on', then press [LEVEL] to decrease the output power. To set to factory default, press and hold [LEVEL] for 3 sec.

Note: This function is not available on the LED source option.

DISCLAIMER AND WARRANTY

Information in this manual is given in good faith for the benefit of the user. It cannot be used as the basis for claims against Kingfisher International or its representatives, if accidental damage or inconvenience results from use or attempted repair of the equipment.

Kingfisher International products are guaranteed against defective components and workmanship for a period of 3 years from the date of delivery, unless specifically stated in the original purchase contract or agreement. This warranty excludes optical connectors or incorrect use. Opening the instrument will invalidate the warranty. Liability is limited solely to repair of the equipment.

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